NASA Facts

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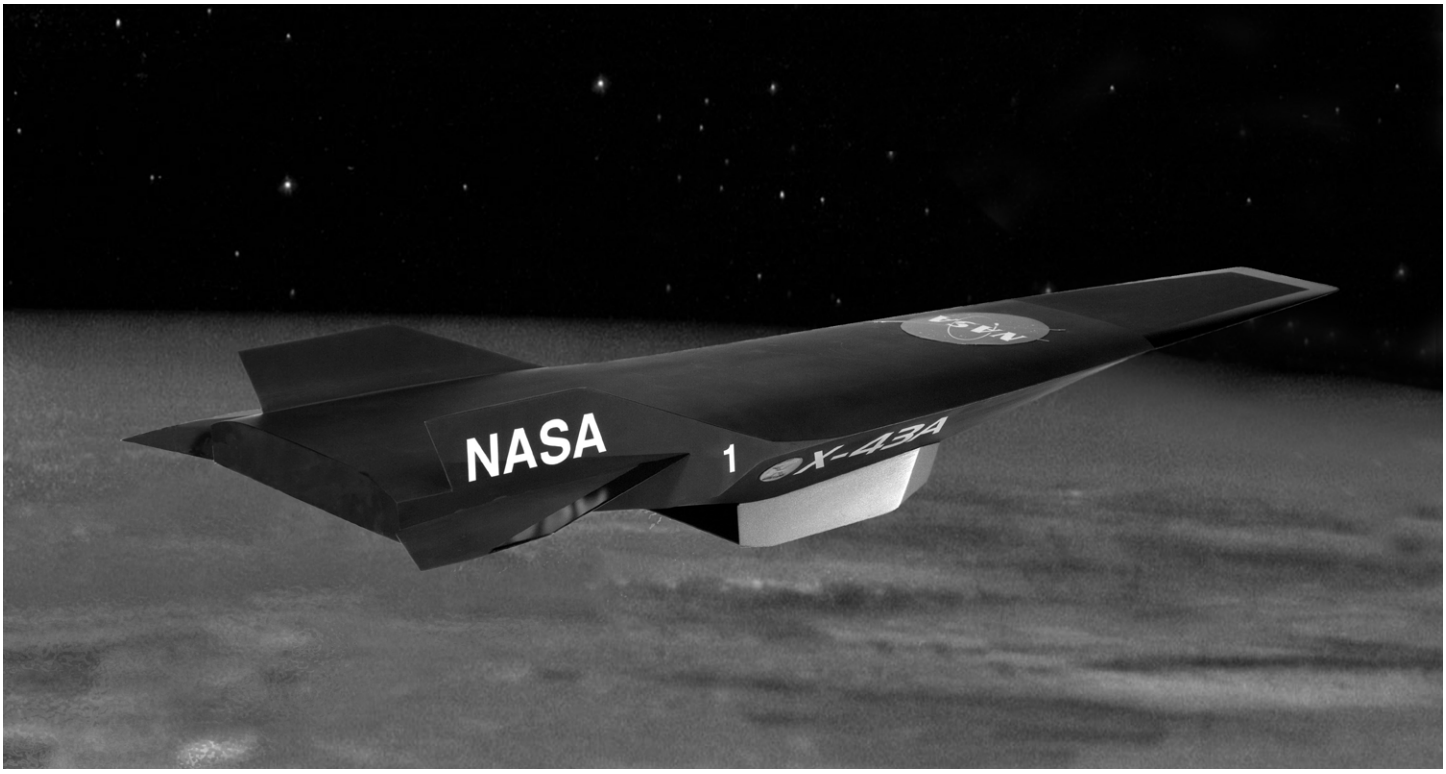
FS-2001-04-040 DFRC



Artist conception of X-43A

Dryden and the Hyper-X Program

Project Background

An experimental hypersonic flight-research program, called Hyper-X, will be among the most significant projects underway at the NASA Dryden Flight Research Center, Edwards, California, during the next few years. NASA Langley, Hampton, Virgina, has overall management of the Hyper-X program and leads the technology development effort.

The multi-year NASA/industry Hyper-X program seeks to demonstrate airframe-integrated, "air-breathing" engine technologies that promise to increase payload capacity for future vehicles, including hypersonic aircraft (faster than Mach 5) and reusable space launchers.

Conventional rocket engines are powered by mixing fuel with oxygen, both of which are traditionally carried onboard the aircraft. The Hyper-X vehicles, designated X-43A, will carry only their fuel — hydrogen — while the

oxygen needed to burn the fuel will come from the atmosphere. By eliminating the need to carry oxygen aboard the aircraft, future hypersonic vehicles will have room to carry more payload. Another unique aspect of the X-43A vehicle is that the body of the aircraft itself forms critical elements of the engine, with the forebody acting as the intake for the airflow and the aft section serving as the nozzle. These technologies will be put to the test during a rigorous flight-research program at NASA Dryden.

NASA Dryden's Role

NASA Dryden has several major roles in Phase I of the Hyper-X program, which is a joint Dryden/NASA Langley Research Center program being conducted under NASA's Aeronautics and Space Transportation Technology Enterprise. Dryden's primary responsibility is to fly three unpiloted X-43A research vehicles to help prove both the engine technologies, the hypersonic design tools and the hypersonic test facilities developed at Langley.

Through this Langley/Dryden/industry partnership, the Hyper-X program fulfills a key Agency goal of providing next-generation design tools and experimental aircraft to increase design confidence and cut the design cycle time for aircraft.

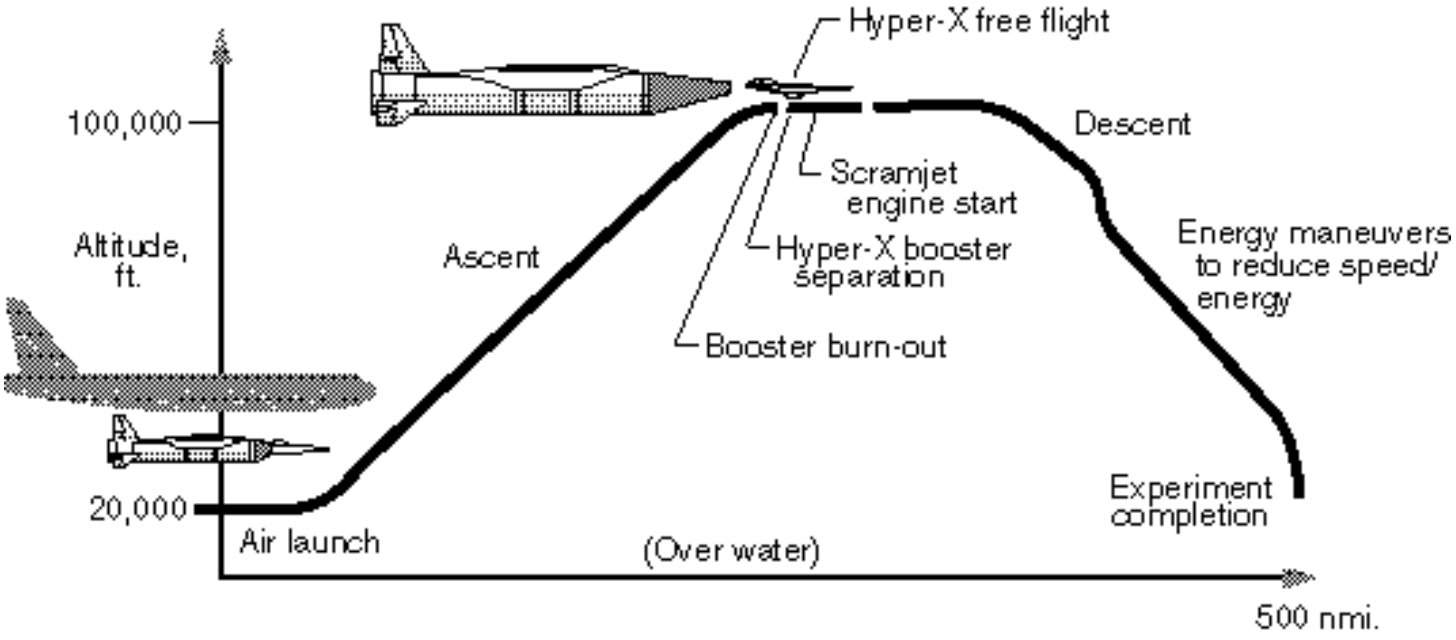
Specifically, Dryden will:

- Fly three unpiloted X-43A vehicles.
- Evaluate the performance of the X-43A research vehicles at Mach 7 and 10.
- Demonstrate the use of air-breathing engines during flights of the X-43A vehicles.
- Provide flight research data to validate results of wind tunnel tests, analysis and other aeronautical research tools used to design and gather information about the vehicles.

As the lead Center for the flight-research effort, Dryden engineers are working closely with their colleagues from Langley and industry to refine the design of the X-43A vehicles. Dryden also is managing the fabrication of both the X-43A vehicles and the expendable booster rockets that will serve as launch vehicles. Dryden also will perform flight-research planning as well as some vehicle instrumentation and provide control of the tests.

Unlike conventional aircraft, the X-43A vehicles will not take off under their own power and climb to test altitude. Instead, NASA Dryden's B-52 aircraft will climb to about 20,000 feet for the first flight and release the launch vehicle. For each flight the booster will accelerate the X-43A research vehicle to the test conditions (Mach 7 or 10) at approximately 100,000 feet, where it will separate from the booster and fly under its own power and preprogrammed control.

Flights of the X-43A will originate from the Dryden/Edwards Air Force Base area, and the missions will occur within the Western Sea Range off the coast of California. The current flight profile calls for launch-



ing the X-43A vehicles heading west. The flight path for the vehicles varies in length and is completely over water.

The B-52 Dryden will use to carry the X-43A and launch vehicle to test altitude is the oldest B-52 on flying status. The aircraft, on loan from the U.S. Air Force, has been used on some of the most important projects in aerospace history. It is one of two B-52s used to air launch the three X-15 hypersonic aircraft for research flights. It also has been used to drop test the various wingless lifting bodies, which contributed to the development of the Space Shuttle. In addition, the B-52 was part of the original flight tests of the Pegasus booster. Modified Pegasus® boosters will serve as the launch vehicles.

Current Status

The first of three hypersonic (X-43A) research vehicles started the final preparations toward a flight in early summer 2001, as the second vehicle arrived on January 31, 2001, at NASA's Dryden Flight Research Center, Edwards, California.

On Aug. 11, 1998, the first piece of hardware was delivered to NASA — a scramjet engine that will be used for a series of ground tests in NASA Langley's 8 Foot High Temperature Tunnel. This engine could later be used for flight if necessary.

Orbital Sciences Corp., Dulles, Va., is designing and building three Pegasus-derivative launch vehicles for the series of X-43A vehicles, a process that Dryden will oversee. A successful critical design review for the launch vehicle was held at Orbital's Chandler, Ariz., facility in December 1997.

NASA selected MicroCraft Inc., Tullahoma, Tenn., in March 1997 to fabricate the unpiloted research aircraft for the flight research missions, two flights at Mach 7 and one at Mach 10 beginning in 2000. Micro-Craft is aided by Boeing, which is responsible for designing the research vehicle, developing flight control laws and providing the thermal protection system; GASL Inc., which is building the scramjet engines and their fuel systems and providing instrumentation for the vehicles; and Accurate Automation, Chatanooga, Tenn.

Air-Breathing Scramjet Engine Technologies

This challenging ground and flight-research program will expand significantly the boundaries of air-breathing flight by being the first to fly a "scramjet" powered aircraft at hypersonic speeds. Demonstrating the airframe-integrated ramjet/scramjet engine tops the list of program technology goals, followed by development of hypersonic aerodynamics and validation of design tools and test facilities for air-breathing hypersonic vehicles. The scramjet engine is the key enabling technology for this program. Without it, sustained hypersonic flight could prove impossible.

Ramjets operate by subsonic combustion of fuel in a stream of air compressed by the forward speed of the aircraft itself, as opposed to a normal jet engine, in which the compressor section (the compressor blades) compresses the air. Unlike jet engines, ramjets have no rotating parts. Ramjets operate from about Mach 2 to Mach 5.

Scramjets (supersonic-combustion ramjets) are ramjet engines in which the airflow through the whole engine remains supersonic. Scramjet technology is challenging because only limited testing can be performed in ground facilities. Long duration, full-scale testing requires flight research. Hyper-X will help build knowledge, confidence and a technology bridge to very high Mach number flight.

Currently, the world's fastest air-breathing aircraft, the SR-71, cruises slightly faster than Mach 3. The highest speed attained by NASA's rocket-powered X-15 was Mach 6.7. The X-43A aircraft is designed to fly faster than any previous air-breathing aircraft.

Hyper-X Vehicle Specifications

- Length: approximately 12 ft
- Weight: approximately 2,200 lb
- Performance: Mach 7-10

Three view of Hyper-X aircraft

Hyper-X Fast Facts

- Goal: To prove “air-breathing” hypersonic engine technologies and hypersonic aircraft design tools
- Vehicles: Three unpiloted X-43A vehicles, Pegasus-derivative launch vehicles, and B-52
- Flight schedule: Three flights, two at Mach 7, followed by one at Mach 10.
- Partners: NASA Langley Research Center, Hampton, Va., program management and technology lead; NASA Dryden Flight Research Center, Edwards, Calif., flight-research lead and contracting agency; MicroCraft Inc., X-43A vehicle fabrication; Orbital Sciences Corp., launch vehicle fabrication.